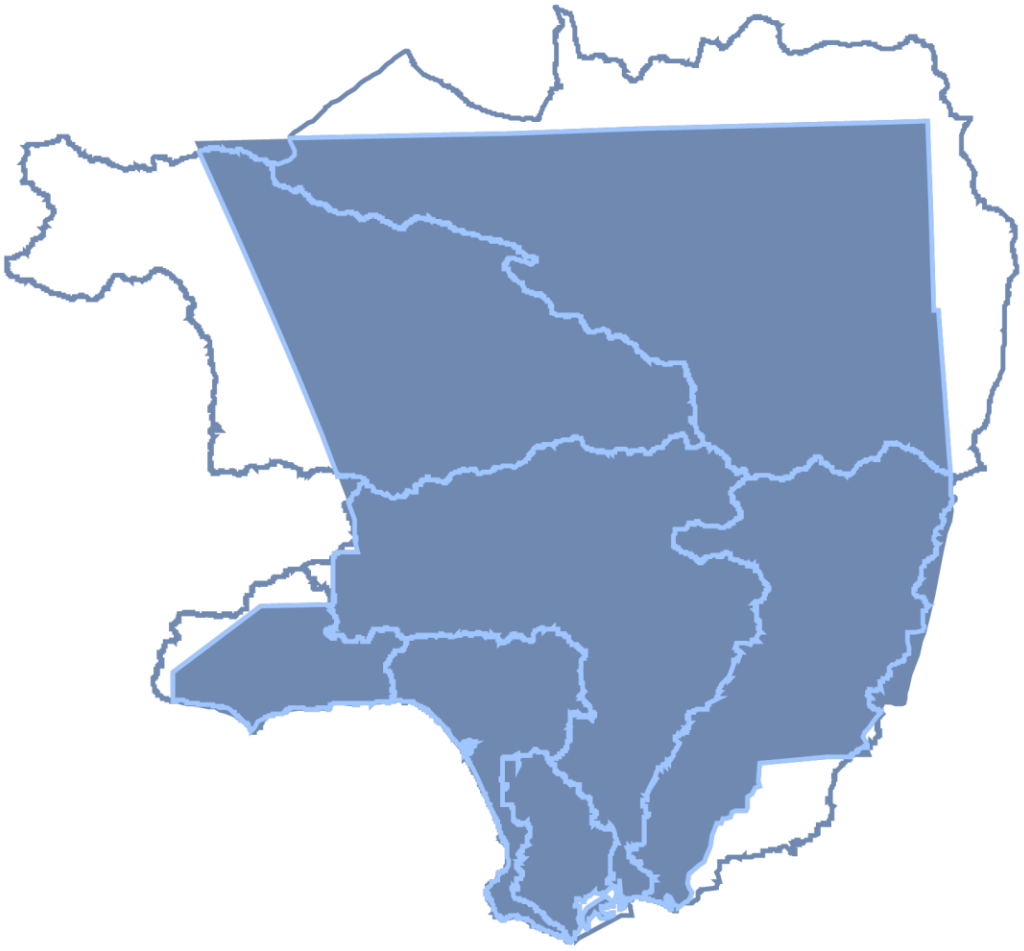
The Los Angeles County Watershed Management Modeling System Loading Simulation Program in C++ User's Manual



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1. Installation

The installation package can be found at www.LACountyWMMS.com

The installation package zip file extracts three folders:

\MapWindow
\LAC-WASOP
\DATA

The installation process consists of three steps

Step 1: Install the MapWindows GIS Software
In the \MapWindow folder, run the MapWindowx86Full-v48Final-installer.exe file

Step 2: Install the Model Software
In the \LAC_WASOP folder, run the LSPC_MapWindow.smi file to install the LSPC model software

Step 3: Install the data files
On your local C: drive, create a folder named C:\LA_MapWindow, and then copy the \DATA folder into it, such that you have the following folder structures on your computer

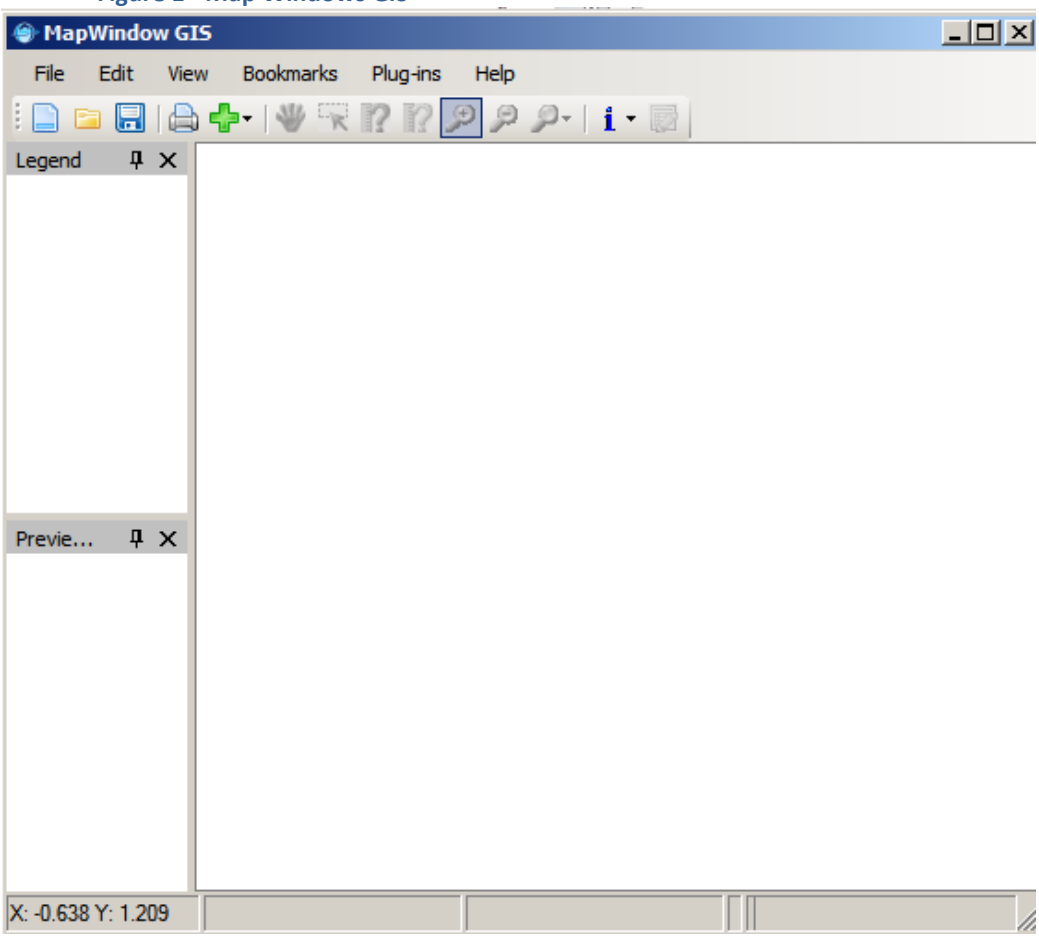
- C:\LA_MapWindow\DATA\Shapefiles\, which includes shapefiles of the GIS coverage of the entire LA County LSPC watershed model and compliance points for water quality impairments (which will only be used for the Regional Optimization portion of WMMS)
- C:\LA_MapWindow\DATA\Weather\, which includes all the weather files for the entire LA County LSPC watershed model
- C:\LA_MapWindow\DATA\Database\, which includes a Microsoft Access database file:
    - LSPC_V4-1-0_LAC-WASOP.mdb: includes the necessary coefficients for the Regional Optimization and the LSPC simulations.

2. Using the Software

Step 1: Start the MapWindows GIS interface

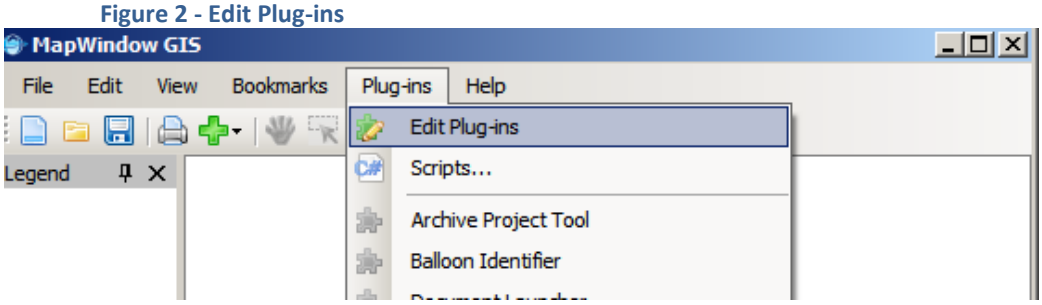
Run the MapWindows icon from your desktop icon or from your Windows Start Menu as shown in Figure 1.

Figure 1 - Map Windows GIS



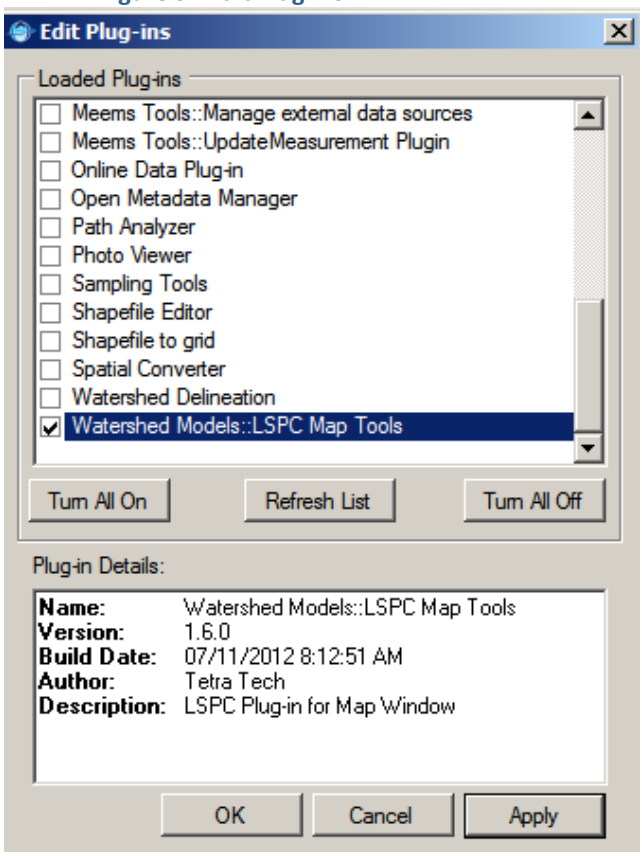
On the menu bar, click **Plug-ins** and select **Edit Plug-ins** as shown in Figure 2**.**

Figure 2 - Edit Plug-ins



At the bottom of the Edit Plug-ins list, check Watershed Models: LSPC Map Tools and click Apply **as shown in** Figure 3**.** The LSPC and NIMS menus are activated.

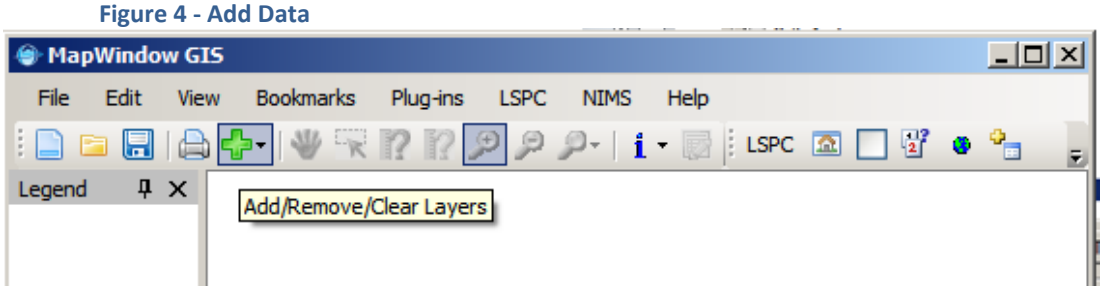
Figure 3 - Edit Plug-ins



Step 2: Creating a new MapWindows Project

GIS data (Shapefiles) can be added using the + icon on the toolbar as shown in Figure 4. Click on the + and browse to C:\LA_MapWindow\DATA\Shapefiles\ and add all the shapefiles into the project.

Figure 4 - Add Data



Save the MapWindow File as **LSPC_GIS.mwprj** in C:\LA_MapWindow. This will be the file you open whenever you want to run the model.

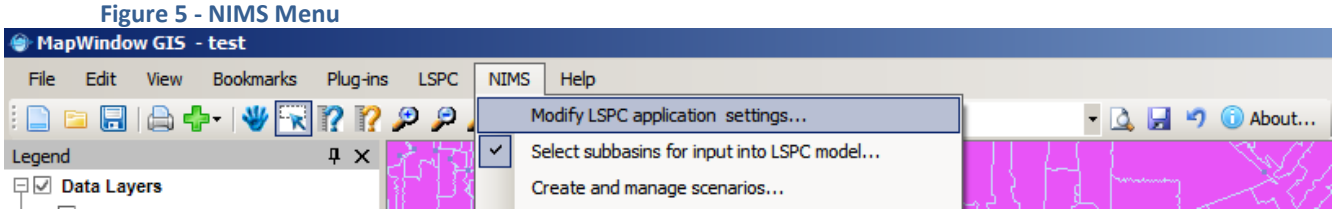
Step 3: Configuring LSPC

First set up the Regional Optimization Menu (NIMS)

The regional optimization menu must be set up for LSPC to function properly. The configuration will only have to be set up once.

Click the **NIMS** menu, click **Modify LSPC application settings as shown in** Figure 5**.**

Figure 5 - NIMS Menu

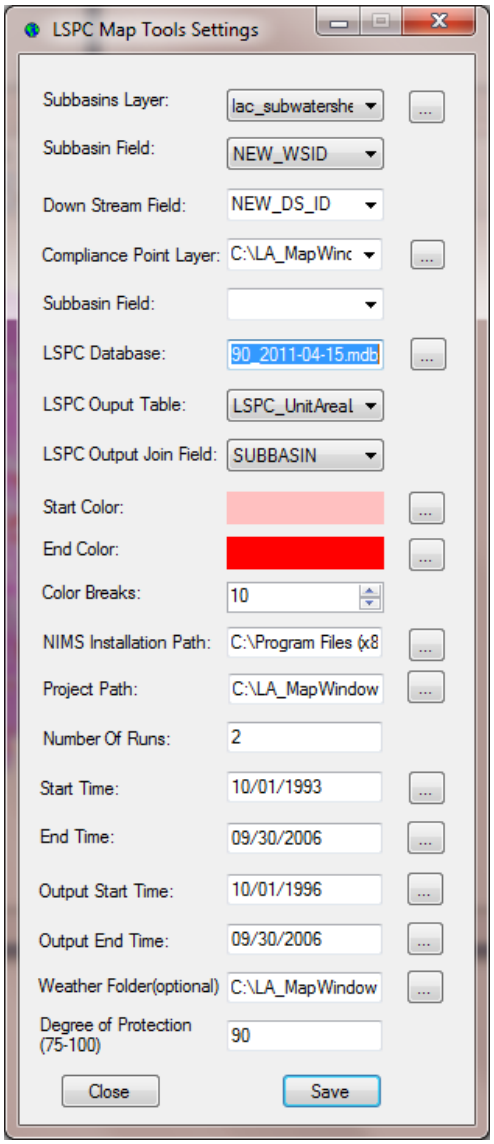


Fill in the proper value in each line using the information below as shown in Figure 6.

Subbasins Layer: For this item, browse to C:\LA_MapWindow\DATA\Shapefiles, and select lac_subwatershed.shp. This is the subwatershed layer.
Subbasin Field: From the dropdown list, select **NEW_WSID.** This is the ID of the subwatershed field.
Down Stream Field: From the dropdown list, select **NEW_DS_ID.** This is the ID of the downstream watershed.
Compliance Point Layer: You can leave it blank, or browse to C:\LA_MapWindow\DATA\Shapefiles, and select lac_compliance_points.shp. (This is for the Regional Optimization compliance point)
Subbasin Field: Leave blank
LSPC Database: Browse to the folder C:\LA_MapWindow\DATA\Database, and select the .mdb file. This is the database that has all the input parameters stored.
LSPC Output Table: From the dropdown list, select **LSPC_Unit/Areal**. Currently there is only one item in the list.
LSPC Output Join Field: From the dropdown list, select **SUBBASIN**
Start Color: Leave unchanged
End Color: Leave unchanged
Color Breaks: Leave unchanged
NIMS Installation Path: Browse to the folder where the LA-WASOP core model is installed. The path is likely to be C:\Program Files\MapWindow\Plugins\WatershedModels\LSPC
Project Path: Specify the folder where you will store the scenario analysis. It is recommended that the project path would be a new folder under C:\LA_MapWindow.

The remainder of the settings is for the Regional Optimization, but need to be set up to run LSPC. If you would like more details about what these settings mean or how to run the Regional Optimization, please refer to the Regional Optimization Manual

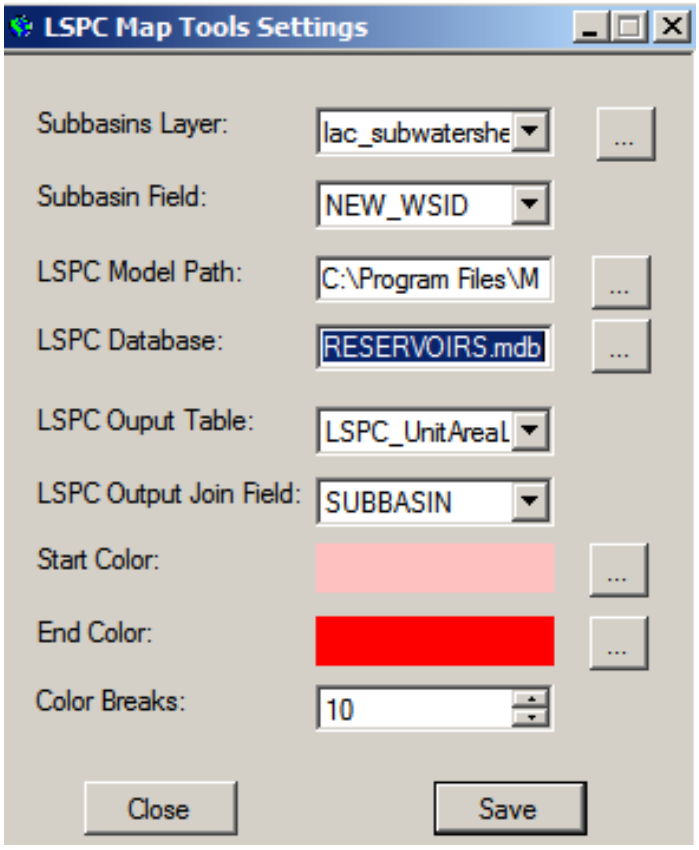
Figure 6 - NIMS settings



Number of Runs: Input "7"
Start Time: Input **10/01/1998.**
End Time: Input **09/30/2006**
Output Start Time: Input **10/01/2000.**
Output End Time: Input **09/30/2006**.
Weather Folder (optional): C:\LA_MapWindow\DATA\Weather,
Degree of Practice (75-100): Input 75

After all the values are filled, click **Save**, and then **Close**.

Figure 7 - LSPC Settings



To verify that the LSPC Settings are correct, click **LSPC Menu**, click **Modify LSPC application settings**.

Ensure that they are correct as shown in Figure 7.

Subbasins Layer: lac_subwatershed.shp.
Subbasin Field: NEW_WSID.
LSPC Model Path: C:\Program Files\MapWindow\Plugin\LSPC\LSPCModel.exe.
LSPC Database: C:\LA_MapWindow\DATA\Dabase\LSPC_V4-1-0_LAC-WASOP.mdb

The following inputs parameters are for viewing the results on MapWindows and do not affect the model runs.

LSPC Output Table: LSPC_UnitAreaLoad.
LSPC Output Join Field: select SUBBASIN.
Start Color: pink.
End Color: red.
Color Breaks: 10.

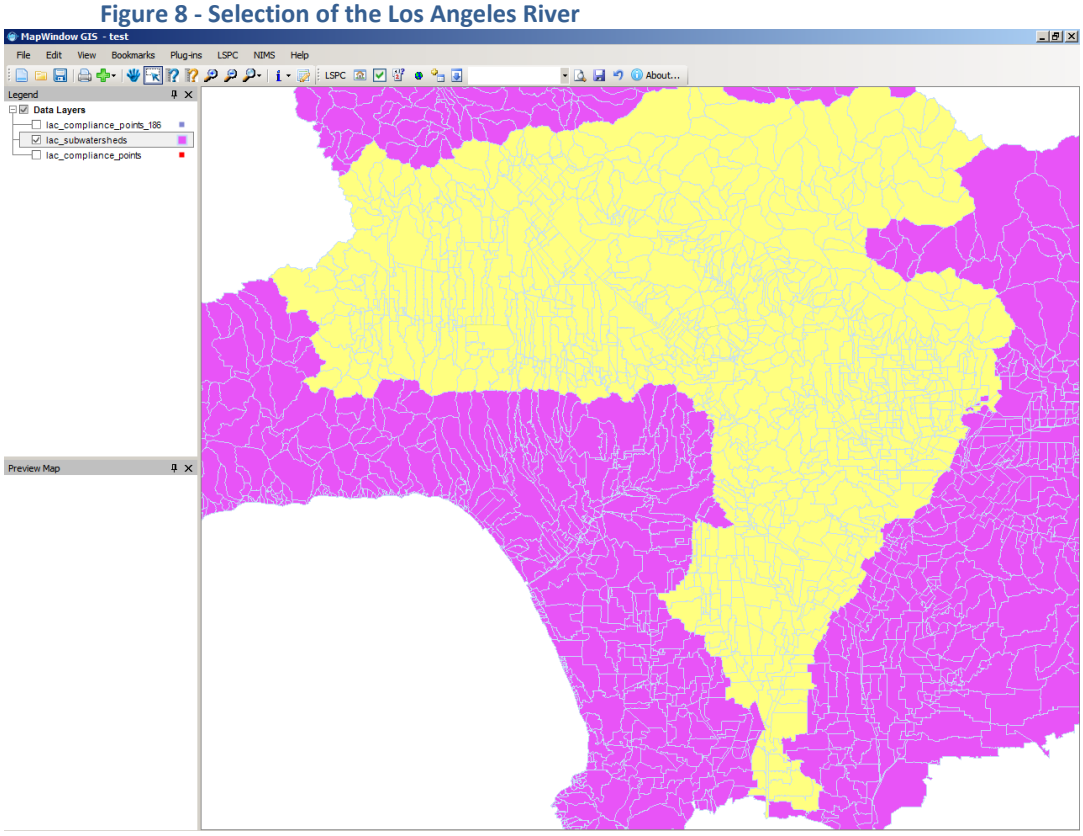
You have finished setting up the LSPC settings.

Step 4: Set subbasin selection option
Click the **LSPC** menu and select **Select subbasins for input into the LSPC model**

It will prompt you to **"Include upstream subbasins in selection"**
You can either select an individual basin for analysis or a watershed (by selecting the downstream basin). It depends on the application of the WMMS.

Try clicking on some watersheds to try out selecting watersheds

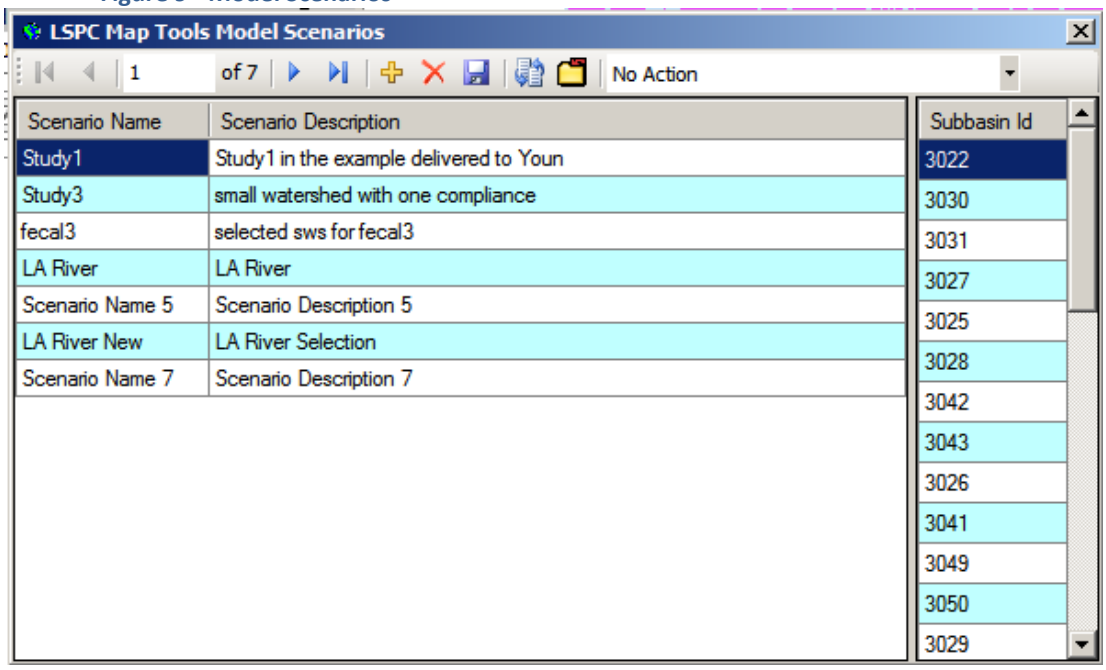
Figure 8 - Selection of the Los Angeles River



Step 5: Manage Scenarios

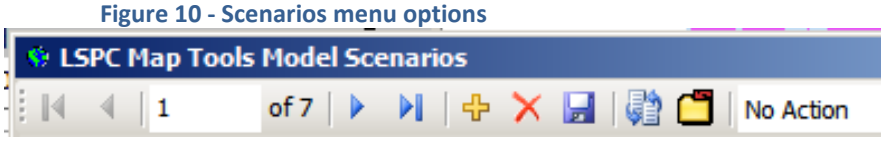
In order to save subbasin selections, Scenarios can be used. Click **LSPC** then Click **Create and Manage Scenarios**

Figure 9 - Model Scenarios



The Scenario name and descriptions are on the left side of the box and the selected subbasin IDs are on the right side. You can either click on the scenario or use the arrow buttons to browse through scenarios.

Figure 10 - Scenarios menu options



New scenarios can be made by clicking the **+** button.
Scenarios can be deleted using the **X** button.
Changes to scenarios can be made by clicking the **save** button.

There are two choices that can be made to a scenario.
If you click on the **"No Action"** dropdown menu, you will see

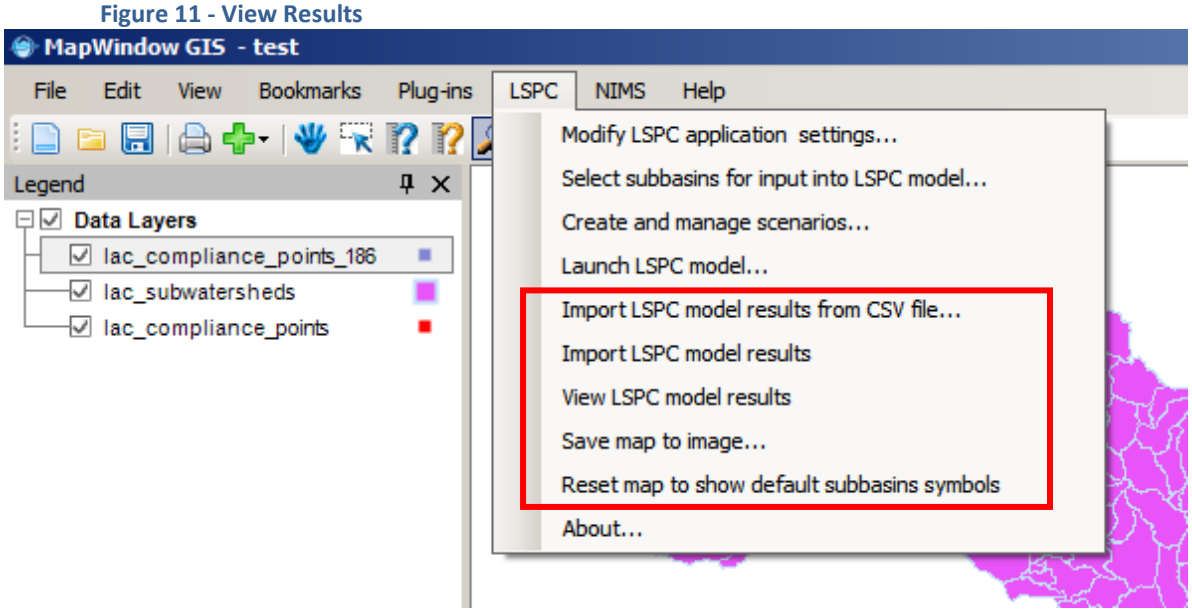
1. **Update scenario subbasins with map selection** - Basins that are already selected can be updated to a scenario
2. **Update map subbasin selection with scenario -** Basins can be selected from a previous scenario.

The apply button (looks like the refresh button) must be clicked after the dropdown menu selection in order to apply the changes. The scenarios can be closed by clicking the close button (looks like a yellow sticky note).

Try creating some new scenarios.

Step 6: Viewing Results
Before we launch the model, let's go over how to view the model results in MapWindow using the LSPC menu as shown in Figure 11.

Figure 11 - View Results

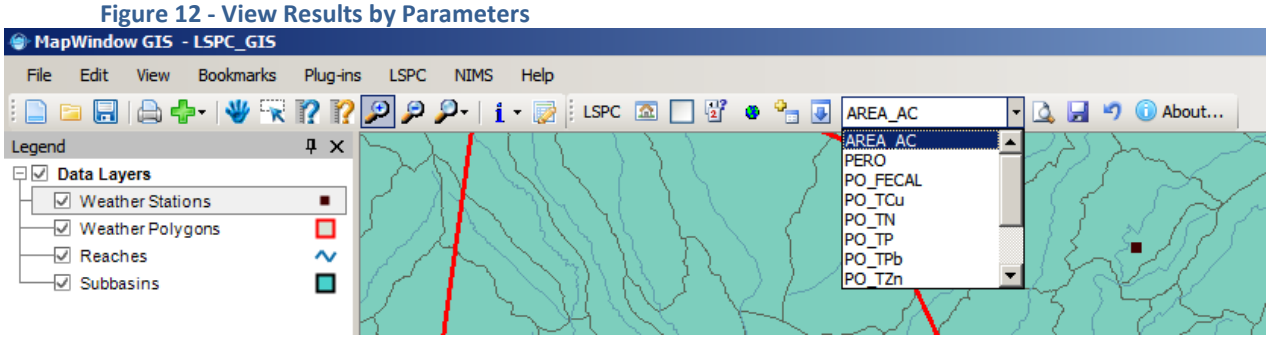


These steps highlighted in red allow you to view the results of LSPC in Mapwindows.

In order to use these settings, the results from a model run must be loaded into the lac_subwatershed.shp file or a .csv file with the model results can be imported as well.

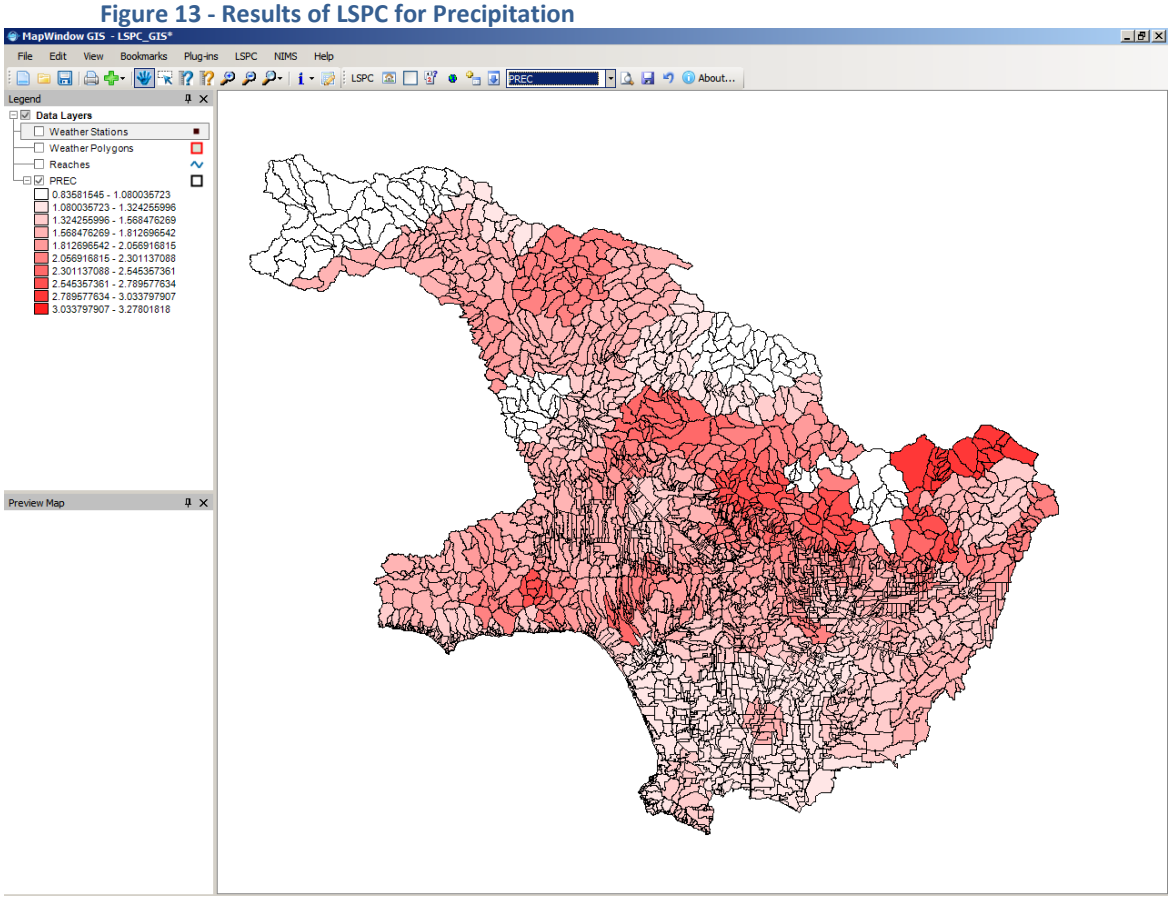
Click LSPC, Click Import LSPC model results (if data is copied to .shp file) or Import LSPC model results from CSV file, the drop down menu on the LSPC toolbar should populate as shown in Figure 12.

Figure 12 - View Results by Parameters



You can select the pollutant you would like to view on the map. Select a Pollutant then click **LSPC**, click **View LSPC Model Results** as shown Figure 13.

Figure 13 - Results of LSPC for Precipitation



The image can be saved by clicking **LSPC** then **Save Image**

Results can be imported in the shapefile but a .csv file must be created with all the pollutant loads and matching watershed IDs (including field name).

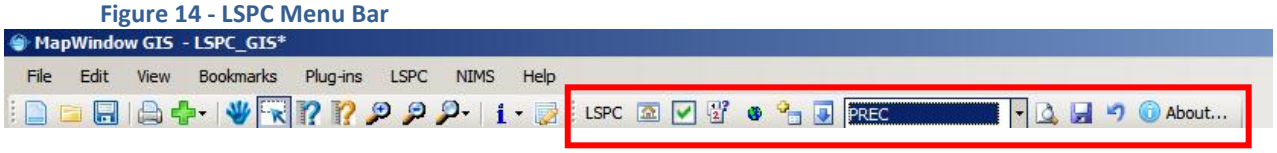
Step 7: Launch LSPC

After the subwatersheds you want to analyze are selected, you can click **LSPC** click **Launch LSPC Model.**

The LSPC model should open.

All the LSPC steps are also available with shortcuts located on the LSPC menu bar as shown in Figure 14.

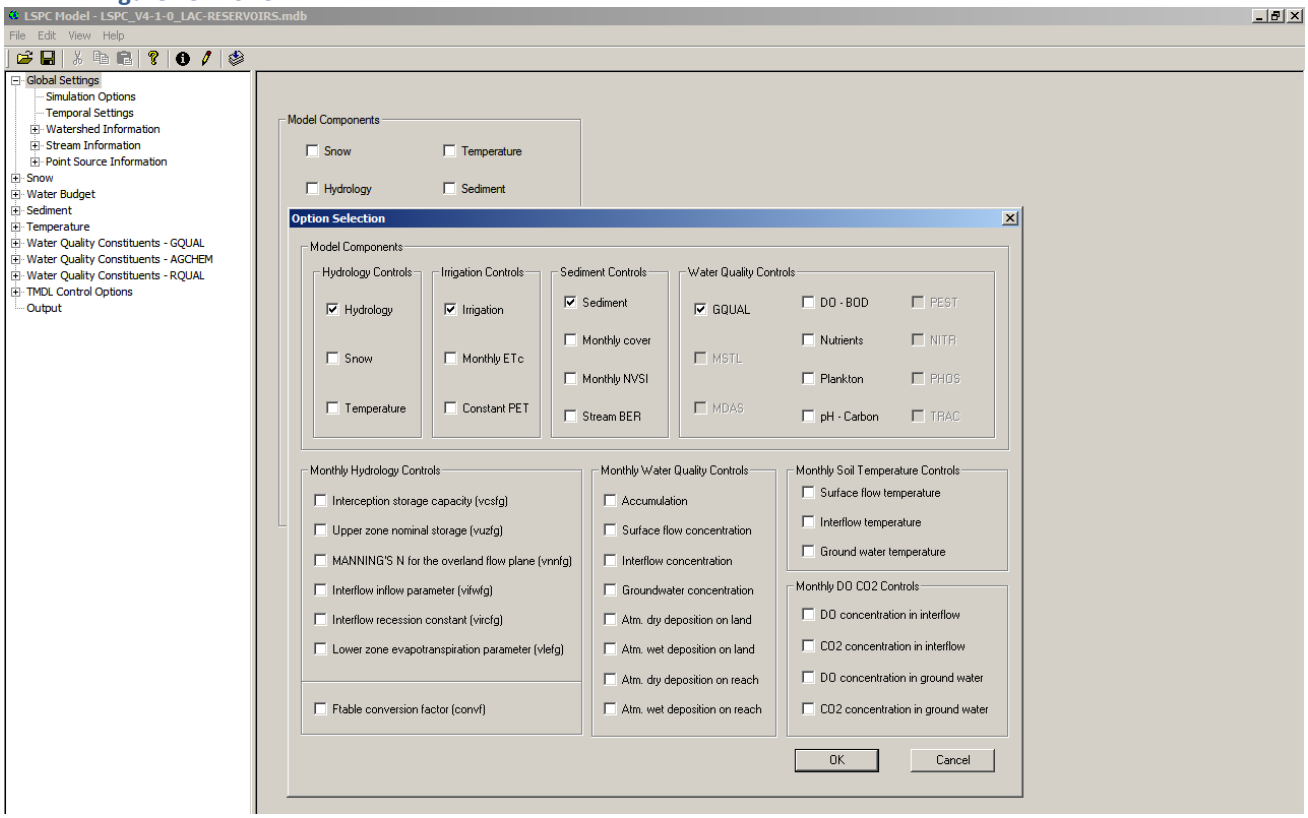
Figure 14 - LSPC Menu Bar



3. LSPC Model

Step 1: Launch LSPC
This should be the first screen that pops up once you launch LSPC. The LSPC model can be further enhanced with many different parameters such as snow and temperature but those parameters are not available at this time. Leave the default checkmarks and click **OK** as shown in Figure 15.

Figure 15 - LSPC



We will now review all the settings on the left side of the LSPC window.

Step 2: Global Settings

Simulation Options:
Only Hydrology, Sediment, and Water Quality should be checked.

Temporal Settings:
Model Input Control: The input time should be at least 6 months prior to the output time to allow the model to have the appropriate initial conditions.

Model Output Control: The output will generate a daily or hourly simulation of the selected subbasins.

The recommended output setting is between 10/1/1996 to 9/30/2006.

The input file can be saved by going to File > Save. An .inp file is saved. If you wish to skip the mapwindows subbasin selection step, you can just open LSPC and open the .inp file.

The LSPC can be opened directly by clicking on
C:\Program Files\MapWindow\Plugins\WatershedModels\LSPC\LSPC_Model.exe

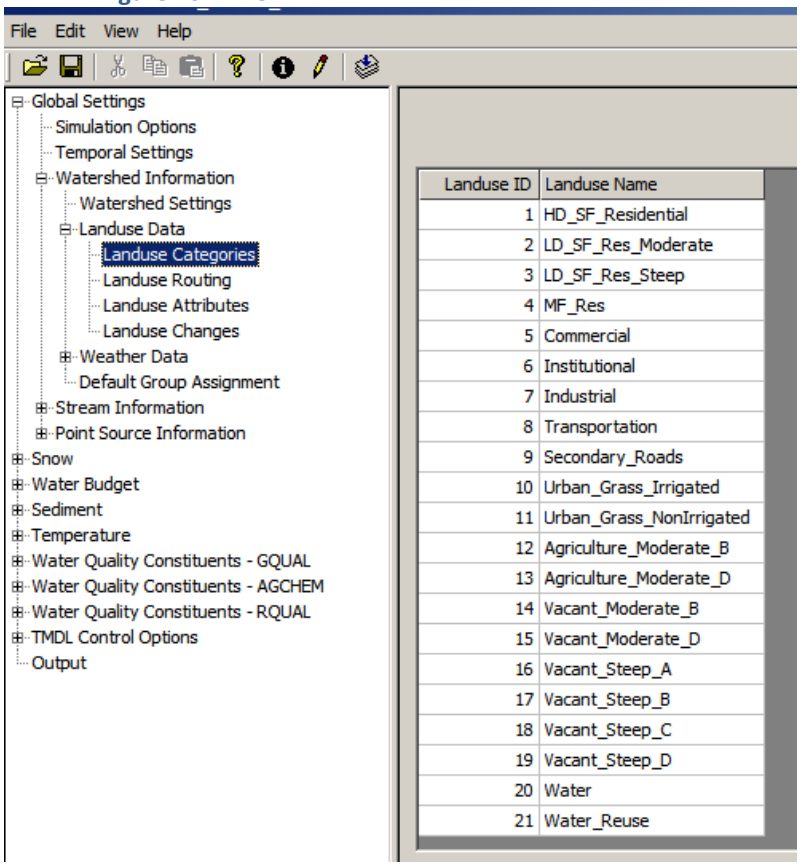
Watershed Information

Watershed Settings– Summary of # of subbasins, streams, and land use

Landuse Data (Land use in this section is referring to HRU). All these sections except attributes should be left alone.

Landuse Categories – Summary of the HRU IDs and Names as shown in Figure 16.

Figure 16 - HRU



Landuse ID	Landuse Name
1	HD_SF_Residential
2	LD_SF_Res_Moderate
3	LD_SF_Res_Steep
4	MF_Res
5	Commercial
6	Institutional
7	Industrial
8	Transportation
9	Secondary_Roads
10	Urban_Grass_Irrigated
11	Urban_Grass_NonIrrigated
12	Agriculture_Moderate_B
13	Agriculture_Moderate_D
14	Vacant_Moderate_B
15	Vacant_Moderate_D
16	Vacant_Steep_A
17	Vacant_Steep_B
18	Vacant_Steep_C
19	Vacant_Steep_D
20	Water
21	Water_Reuse

Landuse Routing – Summary of the subbasin routing parameters
Landuse Attributes – Summary of Subbasin ID and HRUs. If HRU area values need to be updated due to changes in HRU or if you wish to run a simulation of a smaller area within a certain subbasin, then the area values in attributes can be changed in order to simulate that option.
Landuse Changes – You can update landuse but it is not recommended.

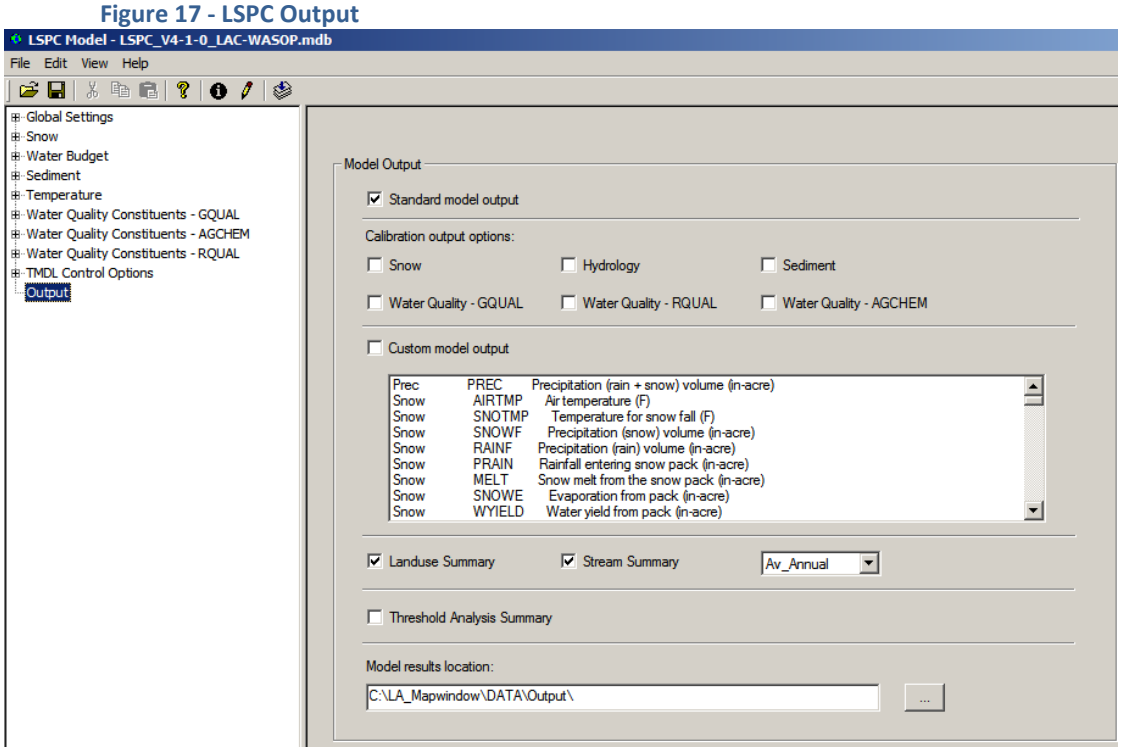
Weather Data. All these sections should be left alone.
Data Location – Folder where weather data is located
File Information – The rain and evaporation gages that are used for this simulation
Station Information – ID information for the gages
Station Selection – Multipliers for the stations

Default Group Assignment – assignment for each subbasin

Stream Information All these sections except Network should be left alone.
Stream Setting
Monthly F(vol) Adjustment Factors
Stream Network – Simulations can be performed for the most downstream basin or all or some of the basins or none at all. Input a "1" in output control if you wish to have an output file for that subbasin. A "0" will not generate an output file.
Stream Characteristics – reaches can also be edited.

Step 3: Output
All values for Snow, Water Budget, Sediment, Temperature, Water Quality, TMDL Control Options should be left to their default values. More information regarding these settings can be found in the LSPC User Manual.

Figure 17 - LSPC Output



Output
Different outputs can be selected for the simulations as shown in Figure 17.

Standard model output

Standard parameters including rainfall, volume, reach flow, total sediment, and pollutant loads. Some parameters are only for the individual subbasin. Other parameters such as reach flow (RO) are a summation of the upstream watershed. The time interval can be set in the temporal settings.

Table 1 shows some key parameters:

Table 1 - Standard Output

Standard Model Output				
Parameter Label	**Description**	**Unit**	**Individual Subbasin Only**	**Includes Upstream Watershed**
PREC	Precipitation	in-acre	X	
SURO	Surface outflow volume	in-acre	X	
RO	Total Reach outflow	cfs		X
SOSED	Total sediment	tons	X	
SSEDOUT	TSS Reach Concentration	mg/l		X
POQUAL	Total Water Quality Flux (includes TN, P, Cu, Pb, Fecal)	lb	X	

Other parameter groupings include Snow, Hydrology, Sediment, Water Quality, or Custom output, however all the basic parameters are included in the Standard Output. If one wishes to only show one parameter such as "RO" then it can be selected in the Custom output box.

Land Use Summary

The land use summary can be used in order to determine the loading rates for different land uses within a subbasin. A subbasin does not need to be selected to generate an output file in the Stream Network Settings in order for the land use summary to be generated. The land use summary will include the entire watershed that was selected in MapWindows and generate an analysis for different parameters for each HRU within a subbasin. The time period can be selected from annual average, yearly, or monthly. Table 2 shows a list of key parameters generated by the Land Use Summary.

Table 2 - Land Use Summary Output

Land Use Summary		
Parameter Label	**Description**	**Unit**
SEDLOAD	Total Sediment	tons
SURO	Total surface outflow	in-acre
PO_TN	Total Nitrogen load	lb
PO_TP	Total Phosphorus load	lb
PO_TCu	Total Copper load	lb
PO_TPb	Total Lead load	lb
PO_TZn	Total Zinc load	lb

Two files will be generated

1. Landuse.csv – this file can be opened in excel and has the numeral values of the analysis
2. Landuse.out – this file can be opened in notepad and has a description and unit of the parameters

Stream Summary

The stream summary can be used in order to determine the monthly, yearly, or annual average totals for the entire watershed or individual watersheds.
Table 3 shows a list of key parameters.

Table 3 - Stream Summary Output

Stream Summary		
Parameter Label	**Description**	**Unit**
IVOL	Total Volume	ft3
RO	Total Reach outflow	cfs
ISED	total sediment load	tons
QUAL_TN	Total Nitrogen load	lb
QUAL_TP	Total Phosphorus load	lb
QUAL_TCu	Total Copper load	lb
QUAL_TPb	Total Lead load	lb
QUAL_TZn	Total Zinc load	lb

Two files will be generated

1. stream.csv – this file can be opened in excel and has the numeral values of the analysis
2. stream.out – this file can be opened in notepad and has a description and unit of the parameters

For total sediment load (ISED), there may be multiple ISED parameters (i.e. ISED1, ISED2, ISED3). The different numbers indicate different soil types. The total sediment can be calculated by summing all the total ISED values.

Even though the parameters have different labels, the land use and stream summary should add up to the same values. For example, the sum of PO_TN in the land use summary should equal QUAL_TN in the stream summary.

Many of the parameters will have the same results. For example, SO_TN (surface flux of TN) and PO_TN (total flux of TN) will be the same. It is assumed the flow is entirely surface flow because IO_TN (interflow) and AO_TN (groundwater flow) will usually be zero.

Threshold Analysis Summary

The Threshold analysis summary generates a statistical analysis of the data.